March 31, 1999

U.S. Environmental Protection Agency
Science Advisory Board
Environmental Models Subcommittee

Summary Minutes of Public Meeting
February 23-24, 1999

Committee: Environmental Models Subcommittee of the U.S. Environmental Protection Agency's Science Advisory Board (SAB). (See Roster - Attachment A.)

Date and Time: February 23-24, 1999 at 8:30 am - 5:00 p.m. Eastern Time (See Federal Register Notice - Attachment B).

Location: U.S. Environmental Protection Agency Administrator's Conference Room, Room 1103 West Tower, 401 M Street, SW, Washington, DC 20460.

Purpose: To review the adequacy of the Council for Regulatory Environmental Monitoring Charter and the Model Acceptability guidance (See Meeting Agenda - Attachment C).

Attendees:

Subcommittee Members/Consultants- EMS members (Dr. Ishwar Murarka [Chair], Dr. Steven M. Bartell, Dr. Calvin Chien [2/23/99 Only], Dr. Kai-Shen Liu, Dr. Paulette Middleton, Dr. M. Bruce Beck, Dr. Linfield Brown, Dr. Helen Grogan, Dr. Wu-Seng Lung, Dr. Jana Milford, Dr. Mitchell Small, and Dr. Thomas Theis All current EMS members except Dr. Gold were present See Attachment A).

U.S. EPA Staff - Dr. Rosemarie Russo, Office of Research and Development/National Exposure Research Laboratory; Ms. Joan Novak, Office of Research and Development/National Exposure Research Laboratory; Dr. Lee Mulkey, Office of Research and Development/National Risk Management Research Laboratory; Dr. Linda Kirkland Office of Research and Development/ National Center for Environmental Research and Quality Assurance; and Mr. King Boynton, Office of Water/Office of Wastewater Management.

Science Advisory Board Staff- Dr. John Fowle, Designated Federal Official; Ms. Karen L. Martin R.S., Life Scientist; and Mrs. Betty Fortune, Management Assistant. (See Meeting Sign-In Sheets for other Attendees - Attachment D)

Meeting Summary:

The meeting followed the issues and general timing as presented in the meeting Agenda, except where otherwise noted (See Meeting Agenda - Attachment C). There were no written comments submitted to the Subcommittee, nor were there any requests made to present public comments during the meeting.

Welcome and Introductions Dr. Ishwar Murarka, Chairman, opened the meeting at 8:40 a.m. welcoming members and consultants (See Roster, Attachment A), and reviewed the meeting agenda (See Attachment C). Dr. Jack Fowle, Designated Federal Official for the Environmental Models Subcommittee, reviewed the materials which had been provided to the Subcommittee and noted that a complete set of materials was available at the meeting for reference purposes. He requested that panel members introduce themselves and make a voluntary statement for the record regarding their research interests and experiences related to the review topic.

Discussion of Subcommittee's Advisory of CREM Charter and Model Acceptability

Update on Environmental Regulatory Modeling Efforts - Dr. Rosemarie Russo of the Office of Research and Development, National Exposure Research Laboratory updated the Subcommittee on the Agency's environmental modeling efforts noting that the Agency is very interested in establishing a guidance document on models to ensure that all offices within EPA are using the same standards. Models 2000 began in December of 1997 with a workshop to address Agency-wide modeling issues and the ATFERM report. It included participants from across the Agency Program Offices, SAB and other areas. The major accomplishments of Models 2000 included identifying issues, forming action teams, establishing the Steering/Implementation Subcommittee, compiling EPA's models inventory and obtaining a consensus on the need for a coordinated effort by the agency. Models 2000 created several Action Teams: Variability/ Uncertainty, Clearinghouse, Multi-Pathway Modeling, New Modeling Paradigm & Collaboration, TMDL, Training, Home Page, Microbiology/Toxicology, Monitoring & Modelers, and Peer Review & QA-Models Acceptability Criteria.

The Steering/Implementation Team (S/IT) was established to implement the Models-2000 recommendations. It set up the Action Teams which developed the draft charter for establishing the Council for Regulatory Environmental Monitoring, and it briefed the Science Policy Council (SPC) and Science Policy Steering Committee on initiating the goals and objectives of Models 2000.

CREM Charter Presentation- Dr. Russo then discussed the CREM Charter. CREM will report to the Science Policy Council (SPC) and may be housed in the Office of Information Management (OIM). Plans are being developed to host annual conferences and establish a clearinghouse for information. The CREM Charter has been rewritten based on the points raised by this Subcommittee in May 1998. After this advisory it is hoped that the CREM Charter will be approved by SPC.

Dr. Murarka reviewed the charge questions and began the discussion. The Subcommittee came to a general consensus that the use of models provide valuable information, that CREM is needed, that it must have some type of authority for it to be effective, and there needs to be a feedback mechanism in place to effectively utilize feedback from users.

Since models are continually evolving CREM should address present and future models. It was noted that while Agency offices want guidance, they also feel the need to maintain some control over model application to effectively run their programs. CREM's role should be to provide guidance, to share information about what is working well and what needs improvement and to coordinate modeling efforts.

Some other areas that should be addressed according to the Subcommittee include: model performance, cost-effectiveness and training. Language should be added to the charter to address the need to ensure model performance. The agency does not have a mechanism in place to determine if a model is effectively completing the desired calculations which form the basis for improving public health. Cost-effectiveness issues definitely need to be included in the charter. The cost of model development, the cost of the user using the model and the value of the information generated will play a vital role in the decision to develop or use a model. A training component must also be included in the charter, because models are becoming more and more complicated. The Action Team on Training is working to establish a training component. CREM could give some guidance in this area. Tutorial programs should be created to allow individuals to train themselves and become familiar with the model. User certification programs are not sufficient and they focus on the process of running a model. The focus should be on solving problems and how to use tools to solve them rather than on the certification of people to use of models. The Subcommittee also suggested that a check list be developed and posted on the website.

At 10:40 am the Subcommittee took a 15 minute break.

Overview & Scope of the Multimedia Integrated Modeling System Development - Ms. Joan Novak of the Office of Research and Development/National Exposure Research Laboratory briefed the EMS on Evolution Towards a Common Modeling Framework for Watershed and Airshed Risk Management. She began her presentation by discussing multi-disciplinary modeling framework issues noting that uncoordinated efforts are difficult to integrate and that scientific and technical issues often intersect (i.e., data handling, computing platforms, etc.). A long-term vision needs to be established to develop a common framework for building, integrating, using complex multi-discipline modeling, and to assess, manage and restore tools. In order to develop a multi-media integrated modeling approach a credible scientific basis for use of models in the decision making process must be established. A computer-based problem solving environment to simplify and facilitate cross-media model development and use also needs to be developed. Another important component of this process is to foster collaboration within EPA, with other agencies, academia and stakeholders.

Architectural Analysis and Prototyping - Mr. King Boynton of the Office of Water/Office of Wastewater Management began his presentation by discussing system complexity. The modeling framework manifests complexity in that it includes multi-media, multi-pollutant, multi-scale and multi-stressor components. In order to handle complexity one must use object-oriented analysis/design and architectural analysis/prototyping. Architectural analysis and prototyping

assures the architecture is robust enough to support component based software, model integration, multi-scale modeling and modeling software product line. Architectural analysis and prototyping also assures fast failure-identification.

Component-based software is being designed to have interchangeable components at different levels of granularity providing users with more flexibility and public access. The code is reusable and it is easier to maintain (debug) software. In addition, software will be easy to retrofit with new innovative science and technology and it will be possible to revise the software to accommodate EPA's evolving programs. Component-based software also enables small component developers to compete at the component level, rather than at the framework level, nurturing innovation and accelerating the evolution of better environmental modeling software.

The Subcommittee adjourned for a one hour lunch at 12:30 pm.

Neuse River Conceptual Model Development - Ms. Joan Novak briefed the EMS on the Multi-Media Integrated Modeling System (MIMS) for Watershed Management. MIMS project scope and objectives include tools to support assessment of Clean Water Act (CWA) requirements. It can be used to assess whether water bodies are fishable and swimmable and can also be used to identify TMDL's; it represents stressor characterizations; it can be used to evaluate cumulative and relative impact of multiple stressors; it can be used to compare mitigation and restoration alternatives; and it can be used to develop strategies to maintain health of fishery resources.

Successful development of broad conceptual models like MIMS requires a multidisciplinary perspective and it needs to be supported by appropriate level of research. The MIMS development strategy includes management, ecological, chemical and physical components. The potential benefits from using this type of model include easy access to improved science to strengthen the basis for decision making; and for formulating integrated approaches to remediation. It is designed to facilitate multidisciplinary collaboration and data exchange. MIMS is being designed to easily incorporate new science and provide access to databases and to rapidly adapt to changes in computing technology.

Model Variability and Uncertainty Analysis - Dr. Lee Mulkey of the Office of Research and Development/National Risk Management Research Laboratory briefed the EMS on the Model Variability and Uncertainty Analysis. The process described in the 1994 white paper were not implemented for a variety of reasons, including limited field/empirical data, limited site specific implementation and expected challenges from regulatory community.

The Subcommittee took a 15 minute break at 2:30 p.m.

Model Acceptability White Paper - Dr. Linda Kirkland from the Office of Research and Development/National Center for Environmental Research and Quality Assurance briefed the EMS on the Model Acceptability White Paper. The workgroup provided an annotated outline

and 5 case histories. An evaluation strategy to illustrate the recommended general guidance has also been developed. This was accomplished through bi-weekly conference calls to discuss options, questions and issues. The white paper was sent out for review by the work group and the Models 2000 S/IT. Responses have been incorporated in the October 1998 draft. Presently there are three options available. The first is to do nothing. The second is for CREM to provide model acceptance criteria, guidance, model information system and to develop a model evaluation process to give EPA's policy makers a set of well developed, well documented and well understood modeling tools to support environmental decision making. The third option is to leave acceptability decisions to Program Managers, but to require accessible information responding to the model acceptance criteria. The option recommended by the workgroup was to combine options two and three.

A proposed strategy was also developed building on the Risk Assessment Forum (RAF) Model Validation Protocol. In order to reach the state of the art approach some components need to be improved. These include making validation part of the evaluation process not the endpoint and to require program specifications which are needed for evaluation. Clarification of Quality Assurance and Peer Review is also included in the proposed strategy. Qualitative and quantitative evaluation criteria is needed as is a need for clarification of record keeping for oversight as well as clarification of certain aspects of the peer review handbook.

Dr. Kirkland ended her briefing by noting the recommendations from the Science Policy Steering Committee to: confine the initial scope of CREM to cover exposure models only; determine resources and housing of CREM; emphasize guidance on how to evaluate and characterize models rather than what to do; develop a model clearinghouse for evaluation results, availability and application experience of programs and regions.

The Models Acceptability work group followed-up these recommendations by canvassing ORD and Program Offices to see if they could find the resources needed for CREM and also a home to house it. The OIM Quality Assurance Division (QAD) has been proposed as a home for CREM, and to provide various support functions.

The EMS thanked Dr. Kirkland and the other Agency staff for their presentations and then began discussing the charge questions.

The meeting was adjourned for the day at 5:00 pm.

Wednesday, February 24, 1999:

The Subcommittee reconvened at 8:00 am to write the first draft of the advisories. It identified the following issues for the CREM Charter:

1. The Subcommittee agreed that CREM is very much needed
2. The Agency should move quickly to establish CREM

3. CREM's goals should be to promote agency actions and behaviors
4. The Agency should identify how feedback will be used from model users
5. CREM should evaluate how well guidelines are being followed and how helpful they are
6. Modelers need to provide clear guidance and examples for how to use their models instead of merely certifying users
7. Since money for training may not be available tutorials built around case studies should be made available for EPA and others.
8. Emphasize the issues not the model during the development and use of models
9. CREM should encourage coordination and outreach to improve model development and use
10. Complete products of the Action Teams approved by SPC should be made available to the public
11. Consideration should be given to adding people from outside EPA on Action Teams
12. The role of CREM should be expanded to include outreach
13. The Agency should be commended for establishing CREM

The Subcommittee then identified the messages it wished to convey for the charge questions for Model Use Acceptability.

Charge Question 1: Please comment on the adequacy of this approach for helping model developers explain their models clearly, articulate major assumptions and uncertainties, identify reasonable alternative interpretations and separate scientific conclusions from policy judgements.

1. The White Paper can provide a basis for a more effective and consistent process of model development and application in the Agency.
2. Model users and environmental analysts will benefit from this approach.
3. The Subcommittee suggests that the Agency consider positive incentives to Program Offices and Regions that develop models to report, document and exchange information on their model QA procedures.
4. Program Offices and Regions should be encouraged to report successes achieved through effective model use.
5. Add a step during articulation of assumptions and hypotheses to include an explicit designation of who is the decision maker.
6. Agency should set criteria for what needs to be included in these assessments and to provide exemplary cases of how it can be done.
7. Assessments should demonstrate the power of tests conducted to differentiate between models that are from those that are not adequate for the specified tasks.
8. The White Paper should define key terms to establish a common nomenclature and use definitions consistently throughout the document and in future work.
9. The Agency should also consider maintaining the distinction between model uncertainty and modeling errors.

Charge Question 2: Is this proposal comparably useful for models for health and for ecological risk assessments as well as for pollution prevention? If not, please identify special needs for any of these general areas.

1. The basic principles of the development and evaluation for different environmental models are the same.
2. The White Paper could be strengthened by including references to other environmental models.
3. The important difference between exposure models and those applied for pollution prevention analyses is that the sphere of pollution prevention lies principally within the private sector. Models must accurately capture the nature of the processes under evaluation, but also must be able to accurately assess cost alternatives.
4. A health risk model should be able to assess chronic health effects based on long-term integrated exposure while predicting acute health effects based on short-term peak exposure.
5. Endpoints of health and ecological risks are important issues that should be addressed.

Charge Question 3: Please comment on the adequacy and utility of the proposal for helping decision-makers, other risk managers and the public: (1) Understand models used in a regulatory context, (2) Evaluate the appropriate use for the results from models in decision making and (3) Understand the unseen aspects of the modeling including choices made during regulatory use and the rationale for those choices.

1. Outreach needs to be directed to stakeholder audiences outside of EPA
2. The Agency needs to ensure that the public, regulatory community and local decision-makers realize the role that values play in the selection of a model and the way a model is used.
3. The Agency should consider developing educational materials to assist stakeholders in the selection, understanding and use of models that address a program's mandates.
4. Tracking model selection by state and local decision-makers will provide a valuable data set to EPA regarding the efficacy of its programs.
5. EPA should provide the principle guidance on the development, selection, appropriate use and limitations of a decision-support model.

The Subcommittee adjourned for a 40 minute lunch at 12:30 p.m.

Charge Question 4: Please comment on the utility of the proposal to help those outside EPA understand the Agency's modeling goals and to help evaluate EPA's progress toward achieving those goals.

1. Establishing a model clearinghouse by the CREM will allow model users to document the model evaluation process and those outside EPA will be able to access this information thereby monitoring the progress.

Charge Question 5: Please comment on the overall utility and adequacy of the proposed "Strategy for Defining Uncertainty in Model Elements and supporting How to guidance" for judging model acceptability.

1. Error propagation associated with the numerical schemes frequently used to approximate mathematical expressions has been omitted.
2. Guidance is needed on how the protocol for model validation should be carried out.
3. A glossary should be added to serve as a basis for common modeling terminology across EPA.
4. The Agency should provide guidance on determining the adequacy of theoretical background and appropriateness of input data.
5. Rephrase uncertainties in model tests arising from the range of statistics used in an assessment or uncertainty about how a test will be made.

The Agency was then debriefed on the preliminary findings of the Environmental Models Subcommittee by Dr. J. Fowle, Designated Federal Official. Immediately following the debriefing, Dr. Linda Kirkland gave a brief presentation on the New Information Office and the EMS chair, Dr. Ishwar Murarka, debriefed the Subcommittee on his meeting with Margaret Schneider, Associate Deputy Administrator of EPA.

Action Item:

The EMS would like to see a presentation on the technology that will be used to test the modeling systems.

Dr. Murarka adjourned the meeting at 3:00 pm.

Respectfully Submitted:

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Dr. John R. Fowle III
Designated Federal Official
Science Advisory Board

Certified as True:

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Dr. Ishwar Murarka, Chair
Environmental Models Subcommittee
Executive Committee

List of Attachments
(from mailings)

Attachment A: Roster
Attachment B: Federal Registrar Notice
Attachment C: Meeting Agenda
Attachment D: Meeting Sign-In-Sheets
Attachment E: Charge
Attachment F: Regulatory Environmental Modeling